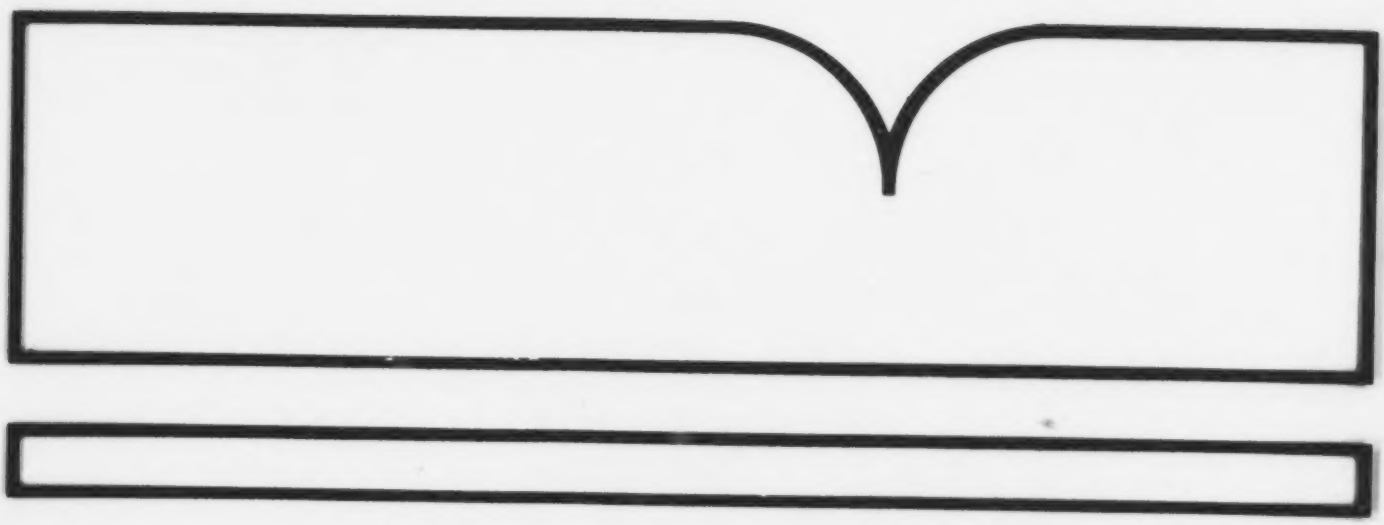
PB83-181131

EPA Evaluation of the Russell Fuelmiser Device under Section 511 of the Motor Vehicle Information and Cost Savings Act

(U.S.) Environmental Protection Agency
Ann Arbor, MI

Sep 82



U.S. Department of Commerce
National Technical Information Service
NTIS

PB83-181131

EPA-AA-TEB-511-82-13

EPA Evaluation of the Russell Fuelmiser Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

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September 1982

Test and Evaluation Branch
Emission Control Technology Divison
Office of Mobile Sources
U.S. Environmental Protection Agency

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
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1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-AA-TEB-511-82-13		PB83 181131

4. TITLE AND SUBTITLE	5. REPORT DATE
EPA Evaluation of the Russell Fuelmiser Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act.	September 1982
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Stanley L. Syria	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS United States Environmental Protection Agency Office of Mobile Source Air Pollution Control Test and Evaluation Branch Ann Arbor, MI 48105	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Same as box 9.	13. TYPE OF REPORT AND PERIOD COVERED Technical
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document announces the conclusions of the EPA evaluation of the Russell Fuelmiser Device under the provisons of Section 511 of the Motor Vehicle Information and Cost Savings Act.

The evaluation of the Russell Fuelmiser device was conducted after receiving an application for evaluation by the marketer. The device is claimed to improve fuel economy and exhaust emissions levels as well as vehicle performance. The device consists of two components; one to chill the fuel and the other to chill the air-fuel mixture. The chilling process is accomplished by installing the above components into the air conditioning system's low pressure refrigerant lines. Additionally, certain parameter changes to the carburetor and ignition systems are also recommended.

EPA fully considered all of the information submitted by the applicant. The evaluation of the Russell Fuelmiser device was based on that information and EPA's engineering judgement. Appropriate data was not submitted showing the device actually delivered a significantly cooler air-fuel mixture to the engine or that it could achieve the benefits claimed. Thus, there is no technical basis for EPA to support the claims made for the device or to perform confirmatory testing.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Automobiles Fuel Consumption Exhaust Emissions Tests	Air-Fuel Device Fuel Economy Gas Saving Device	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release Unlimited	Unclassified	58
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

EPA Evaluation of the Russell Fuelmiser Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

The Motor Vehicle Information and Cost Savings Act requires that EPA evaluate fuel economy retrofit devices and publish a summary of each evaluation in the Federal Register.

EPA evaluations are originated upon the application of any manufacturer of a retrofit device, upon the request of the Federal Trade Commission, or upon the motion of the EPA Administrator. These studies are designed to determine whether the retrofit device increases fuel economy and to determine whether the representations made with respect to the device are accurate. The results of such studies are set forth in a series of reports, of which this is one.

The EPA evaluation of the Russell Fuelmiser device was conducted after receiving an application for evaluation by the marketer. The device is claimed to improve fuel economy and exhaust emission levels as well as vehicle performance. The device consists of two components; one to chill the fuel and the other to chill the air-fuel mixture. The chilling process is accomplished by installing the above components into the air conditioning system's low pressure refrigerant lines. Additionally, certain parameter changes to the carburetor and ignition systems are also recommended. Because this device is intended to modify the engine's induction characteristics, in accordance with 40 CFR 610.21 of the regulations, it is classified by EPA as a air-fuel distribution device.

The following is a summary of the information on the device as supplied by the Applicant and the resulting EPA analysis and conclusions.

1. Title:

   Application for Evaluation of Russell Fuelmiser under Section 511 of the Motor Vehicle Information and Cost Savings Act

2. Identification Information:

   a. Marketing Identification of the Product:

      (1) Title of the Invention (Device): Device and Process for Improving the Performance of an Internal Combustion Engine.

      (2) Marketing Title: Russell Fuelmiser.

   b. Inventor and Patent Protection:

      (1) Inventor

      James M. Russell and James R. Russell
      4805 Polk Avenue
      Alexandria, Virginia 22304

(2) Patent

"Copy of the Patent (Application) is shown as Encl. 1." (Attachment A of this evaluation)

c. Applicant:

(1) Name and Address

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45 L Street, N.W.
B24311
Washington, DC 20024-1611

(2) Principals

James M. Russell, President (DESIGNATED CORRESPONDENT)
James R. Russell, Vice President

d. Manufacturer of the Product:

(1) Name and Address

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Donsco Incorporated
North Front Street
P.O. Box 40
Wrightsville, PA 17368

(2) Principals

(a) Cleanweld Products, Inc.
(1) Charles R. Muirhead, President
(2) Richard D. Shivers, Executive Vice President
(3) Murray McDougal, Chairman of the Board

(b) Donsco Incorporated
(1) Donald Smith, President
(2) William E. Young, Vice President
(3) Arthur Mann, Vice President

3. Description of Product (as supplied by Applicant):

a. Purpose:

"See Enclosures 1 and 2." (Attachments A and B of this evaluation).

b. Theory of Operation:

"See Enclosures 1 and 2." (Attachments A and B of this evaluation).

c. Construction and Operation:

"See Enclosures 1 and 2." (Attachments A and B of this evaluation).

d. Specific Claims for the Product:

A general claim in Attachment B states that, "the invention described herein improves the performance of the internal combustion engine and thereby improves the mileage delivered by a given quantity of fuel and reduces the pollutants emitted by the exhaust system." Attachment B further states that, "test results have varied from a 50 percent increase in fuel mileage, (never less), to a 100 percent increase in fuel mileage". The reader of this report is cautioned not to confuse this last statement, which is an observation of test data obtained from other then EPA recommended procedures (and discussed in Section 6d2), with claims of specific percentage changes that purchasers of the device may realize when using the device.

e. Cost And Marketing Information (as supplied by Applicant):

Cost and marketing information not submitted.

4. Product Installation, Operation, Safety and Maintenance (as supplied by Applicant):

a. Applicability:

"This device (invention) can be installed on, and will function on, all internal combustion engines, foreign or domestic, which possess a functioning air conditioning system as an integral part thereof, or upon which an air conditioning system can be installed. The function of the device (invention) is possible without regard to engine size, type of carburetion (single, dual or four barrel construction), model year, transmission type, or ignition type. The fuel-chilling tank is a standard model for use on all engines.

"The riser (See Encl 1 and 2) [Attachments A and B], is made in two models, i.e., one model for the single and two barrel carburetors and one model for the four barrel carburetors."

b. Installation - Instructions, Equipment, and Skills Required:

"See Enclosures 1 and 2 [Attachments A and B]. NOTE: The following is intended to respond to all inquiries (a) through (f) of application format of para 10.

"Tools and equipment required to install, adjust, maintain, and check the device are commonly available in any installation which performs tune-ups on the engines upon which the device is to be installed and which maintenance and service to the air conditioning systems of such engines is performed. Skills associated with the installation of the device are those necessary to service and perform maintenance on the air conditioning systems, those skills necessary to perform tune-ups on the applicable engines and the skill necessary to change carburetor jets."

c. Operation:

"Operation and installation instructions similar to those contained in Encls 1 and 2 [Attachments A and B], and a period of classroom training -- if necessary -- will be given to all those who will be installing the device."

d. Effects on Vehicle Safety:

"The device in operation, function, or malfunction cannot cause any unsafe condition which would endanger the vehicle, its occupants or persons or property in close proximity to the vehicle."

e. Maintenance:

"No specific maintenance is required on the device, per se. It has no moving parts. The air conditioning system of the engine must however, receive normal maintenance. No additional tools or equipment, other than those needed for air conditioning system service and maintenance and tune-up of the engine are required as a consequence of having installed the device upon any engine."

5. Effects on Emissions and Fuel Economy (submitted by Applicant):

a. Unregulated Emissions:

"No adverse effects upon engine emissions are possible because of the installation, operation, function, or malfunction of the device. Contrariwise, benefits due to a more complete fuel combustion, can be reasonably expected."

b. Regulated Emissions and Fuel Economy:

"See Exhibits 1, 2, 3, and 4 of Encl 1." (Attachment A)

6. Analysis

a. Identification Information:

Marketing Identification:

EPA finds no problems with the titles of the device which are listed in Section 2.A of the application. The reader should note that the Russell Fuelmiser is considered by the applicant to be both a device and a process. The device consists of two components; one to chill the fuel and the other to chill the air-fuel mixture. The process includes the above components in addition to the air conditioning system and certain parameter changes to the carburetor and ignition systems.

b. Description:

(1) The primary purpose of the device/system is to improve vehicle performance, particularly with respect to improved fuel economy and exhaust emission levels. Without additional appropriate test data, the Agency does not know whether or not the device can achieve any fuel economy or emission benefits. The Agency does know that adjustments to the fuel and ignition system, as suggested by the applicant, often cause improved levels of fuel economy. However, these improvements are sometimes accompanied by a degradation in exhaust emission levels and/or performance. Because emission levels may be adversely affected, and also because the device in most instances will likely be installed by commercial automotive service facilities and fleet facilities, the installation of the device (by these facilities), may be considered by the Agency and certain State governments to be an act of tampering. EPA's decision on this concern would be based on exhaust emission results from future test programs.

(2) The theory of operation given in Enclosures 1 and 2 (Attachments A and B) describes the device as consisting of two components which are installed into the low pressure refrigerant lines of an air conditioner system. One component is intended to prechill the fuel being delivered to the carburetor while the other component (referred to as the "riser" by the applicant), which is installed between the carburetor and the intake manifold, is claimed to cool the air-fuel mixture prior to entering the manifold.

Based on the information given, the chilling device should be capable of cooling the fuel to some extent. Whether there are any benefits by doing so is not known by the Agency at this time for the following reasons. Because the chilled fuel passes through other components (e.g., fuel line, fuel filter, and carburetor float bowl) subsequent to becoming chilled, its temperature will rise due to the absorption of heat from those components. The amount of heat absorbed will depend on a number of factors (e.g., component configuration, materials used, engine compartment temperatures, and fuel flow rates) and will vary among vehicles. Depending on the amount of heat absorbed, this reheating of the fuel could potentially negate part or all of any heat loss during the cooling process.

Although Attachment A states that the fuel is cooled to a temperature range of -20°F to 30°F, no mention is made of the final fuel temperature at the carburetor main jet. Additionally, data were not submitted showing final fuel temperatures for modified versus unmodified vehicles or showing the benefits achieved when the fuel chilling device alone is used. Further, because the temperature of the refrigerant upon leaving the expansion valve is generally in the range of 20°F to 34°F, it does not seem possible to cool the fuel to the degree stated above (-20°F to 30°F) unless the refrigerant controls are modified. The applicant did not address any such modifications. Thus, until the applicant submits additional supporting data, the Agency does not know for sure the net decrease in the fuel temperature or whether there are benefits associated with chilling of the fuel.

With respect to the air-fuel mixture cooling device, the Agency is skeptical as to its ability to significantly cool the mixture so as to change the combustion process. This skepticism arises because the device design (see Figures 1 through 6 in Attachment A) suggests that the total cooling surface area in contact with the air-fuel mixture may be insufficient when dealing with the high mixture velocities as found in the fuel induction system. Additionally, as ambient temperatures increase, a greater heat load is placed upon the refrigerant prior to it reaching the riser. Consequently, at very high ambient temperatures, the cooling capabilities may be diminished to the point where proper cooling of the air-fuel mixture is not possible.

For these reasons, EPA requested (see Attachments C and D) additional data showing the air-fuel mixture temperatures from both modified and unmodified vehicles. The applicant responded (Attachment E) that he did not have the requested data. Without additional data, the Agency does not know for sure the cooling capabilities of the air-fuel cooling component. Even if the component could indeed significantly cool the mixture as claimed, there is no assurance this would result in improved fuel economy or emission levels. The cooled mixture may improve the volumetric efficiency and thereby increase the power output of the engine. However, because the lower vapor fraction can adversely affect the charge distribution, it also has the potential to cause driveability problems.

Attachment A states that in addition to the installation of the two cooling components, there are three mechanical adjustments to be made. They consist of a) replacing the carburetor jets with ones of smaller diameter (diameter reduced from 10% to 50%), b) lowering of the carburetor float level, and c) replacing the spark plugs with ones having two or three heat ranges hotter. In a letter to the applicant (Attachment C) EPA asked if there were any other adjustments (e.g., ignition timing, idle mixture, or choke). The applicant responded (Attachment E) that on their test vehicles the spark plugs were changed, the carburetor jets reduced by 10% on one vehicle only, the carburetors adjusted for smoother running (idle mixture assumed) and the ignition timing advanced ten degrees. Based on the applicant's response, it appeared that carburetor jets and float level do not have to be changed/or adjusted on all vehicles. It also appeared that adjusting the ignition timing and carburetor idle mixture is also required on some or all vehicles. Because it was not clear as to exactly what adjustments would be recommended to purchasers of the device, EPA requested (Attachment F) that the applicant clarify the matter. The applicant did not respond to the Agency's questions and therefore, the Agency does not know exactly what adjustments will be recommended. With respect to the adjustments being considered, it is known that fuel economy gains are possible with most of these changes. Depending on the vehicle and the adjustments performed, there may however, also be adverse changes in the exhaust emissions, fuel economy and/or driveability characteristics. Based on the limited information provided by the applicant and also on EPA's experience, it is expected that if there are any benefits associated with the Russell Fuelmiser device/system, they would more likely be caused by the parameter adjustments rather than from the cooling

components. To verify this, the applicant was requested (Attachments C and D) to submit additional data showing the effect of the adjustments alone and also when accompanied with installation of the cooling components. The applicant responded (Attachment E) that he could not fund the necessary testing.

In summary, the theory of operation was sufficiently detailed and therefore EPA had no difficulty understanding how the device/system functions. Although the theory of operation given by the applicant suggests there may be some benefits, sufficient supporting data were not submitted. Therefore, EPA does not know if there are indeed benefits attributable to the device, and if so, whether they more than offset the fuel economy and performance penalties when running an air conditioning system on a full time basis.

(3) The description of the device given in Enclosures 1 and 2 (Attachments A and B) are judged to be adequate.

(4) The device is claimed to improve vehicle performance, particularly with respect to improved fuel economy levels and reduced exhaust emissions. As previously stated in 7(b)(1), actual testing is required to properly quantify these benefits.

(5) The cost of the device plus installation is not known. The Agency requested cost information (Attachments C, D, and F) however, no response was received. EPA estimates the cost of the device alone will not be less than $70. Should the purchaser have the device installed by a commercial service facility, then an additional $100 for labor is expected. The $100 for installation is based on 5 hours of labor at $20 an hour for the shop rate. Five hours is the minimum time likely to be required and was determined based on EPA's knowledge about other retrofit devices (which require approximately 2.5 hours labor) and on air conditioning systems.

c. Installation, Operation, Safety and Maintenance:

(1) Applicability:

The applicability of the product, as stated in the application, seemed to be appropriate except for the statement regarding the number of models required. EPA did question (Attachment C) the applicant regarding his statement that only two models of the riser would be required to accommodate the complete range of carburetors in use today. The applicant responded (Attachment E) that he was not certain that only two models would accommodate

all carburetor/manifold combinations. He further stated that even though he planned to produce risers with multiple bolt patterns, additional risers would probably still be required.

Another concern is the fuel chilling component. The applicant states the component is a standard model for use on all engines. Although the component may be standard with respect to cooling characteristics, EPA is not sure one model will readily connect into all air conditioning and fuel lines because of differences in diameters and fittings. Thus, additional models may be required. Aside from the aforementioned concerns, the applicability of the device seemed reasonable.

(2) Installation - Instructions, Equipment and Skills Required:

With respect to the installation instructions, the applicant referred to Enclosures 1 and 2 (Attachments A and B). These enclosures did not contain the actual instructions which are to be provided to purchasers of the device or to service garages. EPA requested (Attachment C) a copy but the applicant did not respond.

Installation procedures involve the addition of both a fuel cooling component and an air-fuel mixture cooling component in addition to certain parameter adjustments. The installation of the fuel cooling component and the parameter adjustments are not expected to cause any significant problems. The installation of the air-fuel cooling component is expected to be a more difficult matter because it requires the carburetor (and air cleaner) to be raised. Considering that most vehicles have very little clearance between the air cleaner and the hood, this could create a problem. The applicant was questioned (Attachment C) about this potential problem. He responded (Attachment E) that he had experienced a clearance problem on a Cadillac El Dorado, however, it was easily overcome by changing gaskets. Although not stated, it is assumed the gaskets referred to are those located on the top and bottom of the cooling component. Considering the cramped engine compartments and low hood profiles common to today's automobiles, EPA expects the clearance problem to be encountered quite frequently and that it may not always be possible to overcome the problem merely by changing gaskets.

Another potential problem that might occur as a result of raising the carburetor is that caused by external linkages, vacuum and fuel lines, and electrical leads which are connected to the carburetor and/or air cleaner which will

also be raised. This could be a very difficult problem for some vehicles and especially more so for those engines which have the choke thermostatic spring, heat supply tube, or automatic transmission linkages attached to the intake manifold.

Such problems were encountered during a recent EPA test program on another retrofit device which involved raising the carburetor approximately one inch. The installation problems encountered are addressed in the Agency's report EPA-AA-TEB-82-8, titled: Emissions and Fuel Economy of the Turbo-Carb, a Fuel Economy Retrofit Device.

EPA further expects that the problems may preclude installation of the device on some vehicles unless extensive vehicle modifications are performed.

With respect to the tools, equipment, and skills required for device installation, the applicant's comments are judged to be correct. Because the tools, equipment, and skills required are more than those possessed by most individuals, it is expected that most device installations will be performed at service garages.

(3) Operation:

The operating instructions did not include those instructions intended for purchasers of the device. Additionally, the instructions were not clear as to whether the device could be used during all seasons regardless of ambient conditions, and if so, how should the air conditioner controls be set. The applicant was asked (Attachment C) about the seasonal usage and the control settings. He was also asked about the vehicle operation in the eventuality the air conditioner system was not used or it becomes inoperative due to a malfunction. The applicant responded (Attachment E) that the heater and the air conditioner may both be operated at the same time during all seasons. While it is true that air conditioner systems may be operated during all seasons for some vehicles, there are other vehicles in which this is not possible. The reason for this is that some vehicles are equipped with compressor controls (e.g., ambient temperature switches or the compressor discharge pressure switch used in General Motor's Cycling Clutch Orifice Tube system) which are designed to prevent air compressor operation when low outside air temperatures are sensed. This action is intended to prevent damage to the compressor seals, gaskets or reed valves due to lack of proper oil circulation or cold components. Of course, these control switches could be bypassed during installation of the device although it would be at the risk of damaging the air conditioner compressor.

With respect to EPA's question regarding engine operation at times when the air conditioner is not functioning, the applicant responded that the engine would operate, however, it would not achieve nearly the same fuel economy and that it would run hotter and probably diesel. The applicant may be correct, however, it would likely depend on the parameter adjustments made and the amount of cooling achieved of the fuel and air-fuel mixture when the device is functioning. That is, if the device is not really capable of chilling the fuel and air-fuel mixture, then there should not be a noticeable difference in engine operation when the air conditioning is not running.

Because the device is said to cool the fuel and the air-fuel mixture, EPA was concerned about potential operational problems due to icing of the carburetor throttle plate(s) under high humidity/low temperature conditions. This phenomenon occurs when the evaporating fuel absorbs heat from the inducted air and metal parts of the carburetor. The air temperature decreases and water vapor condenses and freezes on the throttle plate(s). The resulting ice buildup can eventually cause rough running and stalling of the engine. Low temperatures can also cause freezing of water within the fuel lines and thereby cause blockage of the lines. These problems have been overcome on modern engines by heating the inducted air and carburetor base (which is opposite the effect of the Russell Fuelmiser), and by fuel anti-icing additives such as alcohol, ammonia salts, and phosphates.

The applicant was questioned (Attachment C) about the potential icing problem and he responded (Attachment E) that the device was not capable of freezing the fuel within the fuel line and that he had not seen any carburetor icing. Without additional data, EPA does not know if icing is a real problem at lower ambient temperatures which can lead to operational problems.

There may also be operational problems due to leaner air-fuel ratios (caused by smaller jets and lowering of the float level). Again, without additional data, EPA does not know for sure if this is a real concern.

(4) Effects on Vehicle Safety:

Because the potential icing problem discussed in Section 6C(3) can cause stalling, there may be instances when the device could cause an unsafe driving situation. However, without additional data, EPA does not know for sure if this is a real hazard.

(5) Maintenance:

Aside from the icing problem mentioned above which can lead to additional maintenance being required, the applicant's statement regarding maintenance appears to be correct when considered on a short term basis. Data were not submitted to EPA showing what affects the lean air/fuel ratios (caused by smaller jets and lowering of the float level) and the hotter range spark plugs may have on engine durability over a longer period of time. Therefore, EPA does not know for sure if more maintenance will be required when considered over a long term basis.

d. Effects on Emissions and Fuel Economy:

(1) Unregulated Emissions:

Based on the design of the device, EPA agrees with the applicant that the device should not cause any adverse affects on nonregulated pollutants. However, without data from the applicant, EPA can not support the applicant's statement that, "Contrariwise, benefits due to a more complete fuel combustion can be reasonably expected."

(2) Regulated Emissions and Fuel Economy:

The applicant did not submit test data in accordance with EPA's recommended test policies which includes both the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET). These two test procedures are the primary ones recognized by EPA for evaluation of fuel economy and emissions for light duty vehicles.* The test data submitted by the applicant consisted of results obtained at the Norris Garage in Forest Heights, Maryland using a Sun

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*The requirement for test data following these procedures is stated in the policy documents that EPA sends to each potential applicant. EPA requires duplicate test sequences before and after installation of the device on a minimum of two vehicles. Additionally, Section 610.41 of the Federal Register Part VIII, dated March 23, 1979 provides that for those devices which require engine parameter adjustments be made, tests will be performed with the parameter adjusted exclusive of the retrofit hardware. Thus, three sets of duplicate test sequences would be required. A test sequence consists of a cold start FTP plus a HFET or, as a simplified alternative, a hot start LA-4 plus a HFET. Other data which have been collected in accordance with other standardized procedures are acceptable as supplemental data in EPA's preliminary evaluation of a device.

Dynamometer and from Custom Engineering Performance and Emissions Laboratories in Garden Grove, California from steady state and FTP and HFET testing. The results from the Norris Garage and the steady state test results from Custom Engineering did indicate some fuel economy gains attributable to the device and are acceptable as supplemental data. However, because of inadequate control of the many variables during the testing, the data cannot be used in lieu of FTP and HFET testing.

The only other testing was that performed by Custom Engineering which consisted of duplicate FTP and HFET tests on only one vehicle in two configurations (with and without the device). Because the testing performed did not meet EPA's minimum test requirements, the data were considered inadequate. EPA requested (Attachments C, D, and F) additional data, however, the applicant did not provide any. The results from the duplicate FTP and HFET showed that although hydrocarbon and carbon monoxide emissions were decreased, the oxides of nitrogen were increased. It also showed that the fuel economy on the FTP was unchanged and that there was a loss on the HFET. Without a third set of duplicate tests, with the parameters adjusted exclusive of the device, EPA does not know if the changes noted above are caused by either the adjustments or the cooling components, or by the combination of these factors.

e. Test Results Obtained by EPA:

EPA did not test the device for this evaluation because the test data submitted by the applicant did not adequately support the claims made for the device.

7. Conclusion

EPA fully considered all of the information submitted by the applicant. The evaluation of the Russell Fuelmiser device was based on that information and EPA's engineering judgment. Appropriate data was not submitted showing the device actually delivered a significantly cooler air-fuel mixture to the engine or that it could achieve the benefits claimed. Thus, there is no technical basis for EPA to support the claims made for the device or to perform confirmatory testing.

FOR FURTHER INFORMATION CONTACT: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Sources, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, Michigan 48105, (313) 668-4299.

List of Attachments

Attachment A	Copy of Enclosure 1, Patent Application (provided with 511 application).
Attachment B	Copy of Enclosure 2, Disclosure Document (provided with 511 application).
Attachment C	Copy of letter from EPA to J.C.A. Corporation, November 16, 1981.
Attachemnt D	Copy of letter from EPA to J.C.A. Corporation, March 24, 1982.
Attachment E	Copy of letter from J.C.A. Corporation to EPA, April 8, 1982.
Attachment F	Copy of letter from EPA to J.C.A. Corporation, May 24, 1982.

Device and Process for Improving the Performance of an Internal Combustion Engine

FIELD OF THE INVENTION

This invention is concerned with improving the performance of an internal combustion engine. More specifically, the invention is concerned with improving the mileage delivered by a given quantity of fuel, especially gasoline, in the internal combustion engine of an automobile.

BACKGROUND OF THE INVENTION

When the internal combustion engine of an automobile is operated, the heat generated raises the temperature within the engine compartment very substantially. The intake manifold and the carburetor may operate, for example, in an environment of several hundred degrees Fahrenheit. This high ambient temperature often vaporizes at least a portion of the fuel in the carburetor fuel bowl. The designs of some carburetors take this into account, and permit vaporized fuel to pass into the atmosphere through the fuel bowl vent.

After an engine has become hot, even after the engine is placed out of operation, the residual heat will often continue vaporizing the fuel in the carburetor fuel bowl. This makes it more difficult to start the engine the next time, because of the low level or absence of fuel in the bowl.

In addition, a heated carburetor heats the fuel-air mixture that is delivered to the intake manifold. The heated fuel-air mixture does not deliver optimum engine performance.

ENCL 1

Some prior workers in this field have sought to improve fuel economy and improve engine performance by increasing the temperature of the fuel-air mixture delivered from the carburetor to the intake manifold. A variety of techniques have been used to accomplish this. In U.S. patent 4,044,742, a device referred to as a fuel expander is employed to heat the fuel to a desired predetermined temperature.

There also have been devices made available for cooling the fuel or the fuel-air mixture, generally to a very limited extent. These have been intended, usually, for purposes other than improving fuel economy or engine performance. For example, in patent 2,885,865, a refrigerant fluid circulated from the air conditioning system of an automobile was employed to cool the fuel line leading to the carburetor. The purpose was to reduce vapor locking tendencies.

In patent 3,332,476, a cooling device of very limited capability was disposed between the discharge outlet of the carburetor and the intake manifold inlet. The purpose was to reduce vaporization of fuel in the carburetor fuel bowl, so as to facilitate restarting the engine.

In patent 3,672,342, a cooling device was disposed to maintain the fuel temperature just ahead of the carburetor, and the air temperature just ahead of the carburetor, within predetermined temperature ranges. The fuel was to be at 70°F to 110°F. The air was to be at 90°F to 110°F. The objective was to control and reduce exhaust emissions. There was also an attempt to improve engine performance, by adjusting the proportions of air and fuel to the optimum for ambient conditions.

A somewhat different approach was taken in patent 3,684,257, where a profiled needle was employed in conjunction with each jet of the carburetor, and in addition, the temperature of air supplied to the carburetor was maintained or attempted to be maintained at a substantially

constant value. However, the objective here was to control emissions, particularly under engine idling conditions, for both hot and cold engine conditions.

The inventor in patent 3,882,692, cooled fuel passing through the fuel line by using cool water accumulated in a reservoir attached to a refrigerant evaporator of an air conditioner. Patent 4,036,188 sought to eliminate vapor lock by the use of a carburetor incorporating a fluid cooling system for a casing of the carburetor. Cooling fluid was circulated through the casing for a predetermined period after the ignition switch was opened, i.e., after the engine was turned off.

SUMMARY OF THE INVENTION

This invention provides means for adjusting the temperature of the fuel-air mixture of an internal combustion engine having a carburetor and an intake manifold. This temperature-adjusting means is disposed intermediate the discharge outlet of the carburetor and the intake port of the manifold. The temperature of the fuel-air mixture is adjusted to not above about 40°F (4°C).

According to one preferred embodiment of the invention, the temperature-adjusting means comprises a thermally-conductive conduit means having at least one passage therethrough. This passage is preferably the same size as the bore of the carburetor barrel, and interconnects the discharge outlet of the carburetor barrel and the inlet port of the intake manifold, to provide communication therebetween for the flow of the fuel-air mixture therethrough. Multiple passages are provided for multiple barrel carburetors.

Heat exchange means are disposed either within, about, or both within or about the conduit means. In one preferred embodiment, this heat exchange means is in the form of a jacket that is disposed about the conduit means, providing a chamber internally of the jacket and about

the conduit, through which heat exchange fluid can be circulated. Temperature adjustment is achieved by circulating refrigerant fluid at a low temperature through the heat exchange chamber, for heat exchange with the fuel-air mixture passing through the passage of the conduit.

In other embodiments of the invention, the heat exchange efficiency is enhanced by providing metallic fins that project into the passage through the conduit, from its wall. Alternatively, to supplement the cooling effect provided by the jacket, or in place of it, a network of tubes may be disposed in the conduit passage, and may even project into the inlet of the intake manifold, to circulate refrigerant fluid; or a combination of all of these may be used.

Preferably, this temperature adjustment of the fuel-air mixture is supplemented by pre-cooling of the fuel, prior to the time the fuel is delivered to the carburetor. In a preferred embodiment, this is accomplished by simple heat exchanger that is mounted near the fire wall in the engine compartment of an automobile.

The cooling is accomplished by the circulation of refrigerant fluid. When the invention is applied to an automobile, the source of the refrigerant fluid at a low temperature may be the air conditioning system of the automobile.

The invention is also concerned with a process for improving engine performance, and particularly, for improving fuel economy and for reducing engine emission. This process involves adjusting the temperature of the fuel-air mixture as it leaves the carburetor, and before it enters the intake manifold, of an internal combustion engine, to a temperature not above about 40°F (4°C), and preferably, within the range from about -20°F (-29°C) to about 30°F (-1°C).

In practicing the invention, three mechanical adjustments are made. Thus, each jet ordinarily present in the carburetor is removed and replaced with a jet having an opening diameter at least 10% smaller than originally present, and preferably, 20% smaller, and most preferably, 30% to 50% smaller; each carburetor float is lowered, to reduce the amount of fuel present in the bowl and to reduce the residence time of the fuel in the bowl; and finally, the spark plugs normally used are replaced with plugs at least two and preferably three ranges hotter than those originally and normally present.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded, fragmentary, isometric view, partly broken away, of a heat exchange device constructed in accordance with one preferred embodiment of the invention, designed for insertion between the discharge outlet of a general type, double barrel carburetor for an internal combustion engine, and the inlet port of the intake manifold (not shown) of the engine, showing the two jets and single float that might be used in such a general type carburetor;

Fig. 2 is a section in a vertical plane through a single conduit, showing heat exchange (cooling) coils disposed within the passage of the conduit, and projecting below the lower end of the conduit so that upon assembly some cooling coils will project into the inlet port of the intake manifold, in accordance with a modified embodiment of the invention;

Fig. 3 is a section taken on the line 3-3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a top plan view of a conduit equipped with heat exchange fins, in accordance with another modification of the invention;

Fig. 5 is a schematic diagram of another embodiment of the invention, in which the operation of the jacket-type

heat exchanger shown in Fig. 1 is supplemented by that of a heat exchanger for the fuel that is being supplied to the carburetor, the source of cooling for both heat exchangers being the air conditioning system of an automobile in which the engine is mounted, the air conditioner being of the compressor type, and

Fig. 6 is a schematic diagram similar to that of Fig. 5, but in which the source of refrigerant fluid is an air conditioning system operated by a refrigerant unit of the gas absorption (Servel) type.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings by numerals of reference, the numeral 10 denotes generally the heat exchange means for adjusting the temperature of a fuel-air mixture, intermediate the discharge outlet of a double barrel carburetor and the intake port of the manifold of an internal combustion engine, in accordance with one embodiment of the invention. This heat exchange means is referred to hereafter for convenience as a "riser", when it is fully assembled as described below.

The riser 10 consists of four main parts. These are a base plate 12, the riser body 14 that, in the assembled riser, is seated on the base plate 12 and welded thereto about its periphery, a top plate 16 that, in the assembled riser, is welded about its periphery to the upper end of the riser body 14, and a pair of generally tubular, upright conduits 18 and 20, that are disposed centrally within the riser body.

The two conduit members 18 and 20 respectively, in the assembled riser, are welded or otherwise secured in fluid-tight fashion to both the base plate 12 and the top plate 16, so that they are rigidly secured in place within the riser. The base plate 12 and the top plate 16 are preferably formed to have the same shape, and each is

provided with a pair of circular openings 22, that are in registry, in the assembled riser, with the passages 24 of the conduit members respectively. As is easily visualized, when the riser is fully assembled, its construction provides a chamber 26 about the conduits 18 and 20 respectively.

The riser 10 is provided with an opening 28 to which a refrigerant fluid supply line 30 is connected. Diametrically opposite the inlet opening 28 in the body of the riser, the riser is provided with an outlet opening in which a refrigerant fluid discharge line 32 is inserted.

The body of the riser and the base and top plates are also provided with other registering openings (shown but not numbered), providing passageways for fasteners for assembling the riser in position at the inlet port of the intake manifold of an automobile engine, and to permit the assembly of a general type carburetor on top of the riser. For simplicity, neither the engine nor the carburetor are shown in the drawings.

However, in the practice of the invention, it is necessary to make some adjustments to the standard equipment of the automobile. For this reason, although the carburetor itself is not shown in the drawing, a float 34 and the main jets 36 are shown in the approximate positions that they would occupy in the carburetor, if it were shown in the exploded view of Fig. 1.

In use, refrigerant fluid is circulated from the supply line 30 into the chamber 26. It circulates about the chamber, in heat exchange contact with the surfaces of the conduits 18 and 20. Eventually it leaves the chamber through the outlet line 32, for return to the refrigerating system, as will be described presently.

The riser body 14 may optionally be provided with inwardly projecting ribs or baffles 38. These serve the dual function of creating turbulence in the refrigerant fluid and thus improving heat exchange, and of strengthening the riser body.

In the embodiment of the invention shown in Fig. 1, heat exchange with a fuel-air mixture passing through the passages 24 of the two conduits 18 and 20 respectively, is accomplished because the conduits are thermally conductive. Somewhat improved heat exchange efficiency can be obtained in the embodiments of the invention illustrated in Figs. 2, 3 and 4.

Referring now to Figs. 2 and 3, the conduit 18' is formed with a passage therethrough 24', for providing communication between one barrel of a carburetor and the inlet port of the intake manifold. Tubing 40 is inserted in fluid-tight fashion through a bore 42 drilled through the wall of the conduit 18'. Within the passage 24' of the conduit, the tubing 40 is wound through a series of convolutions, which generally lie in the same horizontal plane. The tubing is then led out through another bore 44 drilled through the wall of the conduit, again in fluid-tight fashion. As shown in Fig. 2, there may be several levels of such planar windings disposed within the passage of a single conduit. The exterior lengths of the tubing may be connected to a manifold (not shown) at each side of the conduit, one for connection to refrigerant fluid supply, and the other for connection to refrigerant fluid return line.

Alternatively, to simplify fabrication, the wall of the conduit may be penetrated only once for the inlet or supply side of the tubing, and once for the outlet side of the tubing, with all other planar series of convolutions of the tubing being interconnected within the passage in the conduit. Preferably, in addition to the several levels of planar convolutions of tubings, for optimum heat exchange, shown in Fig. 2, at least one planar convolution 46 of tubing is disposed to project below the lower end of the conduit passage, so that upon assembly, that convolution 46 projects into the intake manifold.

Fig. 4 illustrates a somewhat simpler construction for improved heat exchange efficiency as compared to the

structure illustrated in Fig. 1. In Fig. 4, the conduit 18'' is formed with a plurality of thin, radially inwardly projecting fins 48. These are united at their radially inner ends to a thin-walled cylinder 50, for rigidity. The entire structure is metallic for good thermal conductivity.

The operation of the device can be illustrated as installed in an air conditioned automobile equipped with a reciprocating internal combustion engine and a compressor-type air conditioner. The riser illustrated in Fig. 5 has the construction as shown in Fig. 1.

Referring now to Fig. 5, the riser 10, shown in fragmentary fashion in Fig. 5, should be understood to be fully assembled, so that its chamber 26 is completely enclosed. Moreover, it is to be understood to be disposed between the discharge outlet of a double barrel carburetor and the inlet port of the intake manifold. Its refrigerant outlet line 32 is connected to one port of a check valve 52. A second port of the check valve 52 is connected through a line 54 to a compound gauge 56 (both the line 54 and the gauge 56 are shown in phantom). A third port of the check valve communicates through a passage 58 in the head 60 of the compressor of the refrigeration unit with the bore 62 of that cylinder. A second passage 64 provides communication between the bore 62 of the cylinder of the compressor discharge service valve 66. One port of this valve 66 communicates through a line 68 with a high pressure gauge 70 (both the line 68 and the gauge 70 are shown in phantom).

A line 72 is connected to the discharge outlet from the discharge gauge 66, to carry compressed refrigerant fluid through a series of convolutions in the condenser. The refrigerant fluid then passes from the condenser through a line 76, through a check valve 78, into a receiver dehydrator 80, that is equipped with a screen 82 in the usual fashion. A length of tubing is arranged with its

lower end projecting into the receiver dehydrator 80, and with its upper end connected to an expansion valve 86. This valve 86 is arranged with a main discharge line 88 that supplies the expanded, very cold refrigerant fluid to the interior chamber of a heat exchanger 90.

This heat exchanger 90 may be mounted just in front of the fire wall of the automobile, or alternatively, within the air intake line of the air filter, where it will chill incoming air. A coil 92 is mounted within the heat exchanger shell, to carry liquid fuel from a supply line 94 through the coil and to a discharge line 96 communicating with the carburetor. The chamber of the heat exchanger 90, through which the refrigerant fluid circulates, communicates with a line 98, that passes through several convolutions in the evaporator or cooling unit section 100 of the air conditioning system. This is the part of the air conditioner system that is intended to permit cooling of the passenger compartment of the automobile.

After leaving the convolutions in the cooling unit, the line 98 is connected to the refrigerant supply line 30 of the riser 10.

In operation in a typical modern air conditioned automobile, refrigerant fluid is discharged from the compressor through the line 72 at a temperature of about 170°F (77°C). As the refrigerant fluid enters the receiver dehydrator 80, its temperature is about 85°F (29°C). After leaving the expansion valve 86, the refrigerant fluid is extremely cold, and after passing through the liquid fuel heat exchanger 90, the passenger compartment cooling unit 100, and the riser 10, its temperature is about 10°F to 20°F (-12°C to -6°C), typically about 17°F (-8°C).

The outer surface of the riser quickly becomes encrusted with frost and ice. The fuel-air mixture that is traveling through the passages 24 in the conduits of the riser is chilled to a temperature not above about 40°F

(4°C). The drastic decrease in the temperature of the air in the air-fuel mixture, as it passes through the riser, causes moisture to condense out. Consequently the fuel-air mixture passing into the inlet port of the intake manifold carries with it entrained droplets of water, which appear to have a very beneficial effect, in known fashion, on the combustion process.

The fuel entering the carburetor is pre-chilled because of its passage through the heat exchanger 90. The temperature of the fuel leaving the heat exchanger 90 is not above 40°F (4°C) and generally is much lower.

Since the fuel-air mixture is entering the intake manifold at a very low temperature, the density of the mixture is substantially greater than would be the case if both were at ambient temperature. It must be remembered that in normal operating circumstances for an internal combustion engine of an automobile that has been operated for a period of time at a normal rate of speed, the temperature within the engine compartment of the automobile may be as high as several hundred degrees Fahrenheit, so that the temperature of the fuel-air mixture entering the intake manifold would be well above ambient temperature. To accommodate the chilled condition of the fuel-air mixture brought about through use of the present invention, certain adjustments must be made for proper engine performance. First, the float or floats in the carburetor must be lowered, to reduce the residence time in the carburetor. This limits the exposure of the fuel in the carburetor to the ambient temperature in the engine compartment, and helps keep the fuel at either ambient temperature, or at the temperature to which it had been pre-cooled, if a pre-cooling heat exchanger is in use.

Secondly, the opening diameter of the jet or jets of the carburetor must be reduced in size. The reduction in opening diameter should be at least 10%, and preferably is at least 20%, and most preferably, is in the range from

30% to 50%, as compared to normal opening diameter of a standard, unmodified automobile of the same kind.

Third, the spark plugs must be replaced with spark plugs that are at least two ranges hotter than would be normal for an unmodified automobile of the same kind. A spark plug range indicates the ability of the spark plug to dissipate heat through the body of its connector, its insulation, and the cylinder head of the engine, so that only the tip of the plug stays hot. A spark plug range is generally indicated by its number. For example, the spark plug could be a No. 44, a No. 45, or a No. 46. The first numeral, (4), indicates that the plug has a 14 millimeter diameter. The second numeral denotes the heat range of the plug; the higher the number, the hotter the spark plug. A hot plug would be indicated for use when the fuel would enter the intake manifold at a relatively low temperature or in a liquid state. In the case of the present invention, the chilled fuel-air mixture requires hotter plugs than normal for proper ignition. Generally plugs two ranges hotter are satisfactory, but preferably, plugs that are three ranges hotter are used. Some experimentation may be required to optimize engine performance.

While not shown in the drawings previously referred to, all of the refrigerant fluid lines are insulated, as is the line carrying pre-chilled liquid fuel from the heat exchanger 90 to the carburetor.

Demonstrations of the use of the invention on automobiles indicate that use of the invention produces a substantial improvement in the mileage obtained from a given quantity of gasoline fuel. In addition, the quality of the emission from the exhaust is improved substantially. Performance seems to be improved to such an extent that elimination of the catalytic converter appears to be a possibility.

In the modified embodiment of the invention illustrated schematically in Fig. 6, the principal difference from the

embodiment of the invention shown in Fig. 5 is that the refrigeration unit is of the Servel type, operating on the principle of gas absorption. The source of heat that operates the refrigerating unit may be the exhaust system of the car, for great economy.

Referring now to Fig. 6, where primed numerals refer to components similarly identified by the same numerals in Fig. 5, the refrigerant leaving the riser 10 passes through a line 32', and then through the operating portion of the refrigeration unit, generally denoted by the numeral 102. Heat is furnished to this unit by interconnection 104 with the exhaust line of the automobile engine.

While the use of the invention has been discussed here in primarily the terms of its application in connection with reciprocating internal combustion engines for automobiles, it should be understood that the invention can also be employed with reciprocating internal combustion engines in any kind of installation, and with any kind of fuel delivery system to the engine.

While the invention has been disclosed herein by reference to the details of preferred embodiments thereof, it is to be understood that such disclosure is intended in an illustrative, rather than a limiting sense, as it is contemplated that various modifications in the construction and arrangement of the parts will readily occur to those skilled in the art, within the spirit of the invention and the scope of the appended claims.

WHAT IS CLAIMED IS:

1. Means for adjusting the temperature of a fuel-air mixture intermediate the discharge outlet of a carburetor and the intake port of the manifold of an internal combustion engine, comprising:

conduit means having at least one passage therethrough for interconnecting each discharge outlet of a carburetor barrel and an intake port of the manifold, to provide communication therebetween for the flow therethrough of a fuel-air mixture, and

means for circulating a refrigerant fluid in heat exchange relation to said fuel-air mixture within, adjacent, or about said conduit means, for chilling said mixture to a temperature not above about 40°F (4°C).

2. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 1, wherein said means for circulating refrigerant fluid comprises

jacket means disposed about said conduit means, providing a chamber within said jacket and about said conduit means, and

means for circulating refrigerant fluid through said chamber for heat exchange with a fuel-air mixture passing through said conduit means,

said conduit means being thermally conductive.

3. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 1, wherein said means for circulating a refrigerant fluid comprises

tubular heat exchange means disposed within the passage through said conduit means, and

means for circulating the refrigerant fluid through said tubular heat exchange means, for heat exchange with a fuel-air mixture passing through the passage of said conduit means.

4. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 3, wherein said tubular heat exchanger is formed with a portion thereof that projects into the intake port of the manifold.

5. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 3, wherein said tubular heat exchange means is in the form of a network of tubes disposed transversely of the passage through said conduit means.

6. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 2, wherein said conduit means and said jacket are metallic and generally conforms in its peripheral shape in horizontal section to the shape of the base of the carburetor.

7. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 6, wherein said jacket is formed from a generally tubular body that is closed at its upper and lower ends with top and bottom cover plates, said plates being formed with apertures in registry respectively with each passage through said conduit means.

8. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 1, 2, or 3, wherein said conduit means has either single, double, or quadruple passages therethrough, to accommodate a single, double, or quadruple barrel carburetor, respectively.

9. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 1, 2, 3, or 4, wherein said conduit means is formed with wall means defining each said passage therethrough, and with fins that project from said wall means into each said passage, said wall means and said fins being in thermally conductive relation, whereby the surfaces of said fins provide additional heat exchange in each said passage for the fuel-air mixture.

10. Means for adjusting the temperature of a fuel-air mixture in accordance with claim 8, wherein said means for circulating refrigerant fluid comprises the air conditioning system of an automobile in which said engine is mounted.

11. In combination, means for adjusting the temperature of a fuel-air mixture in accordance with claim 1, and

heat exchange means for cooling the fuel to a temperature not above about 40°F (4°C), disposed to cool the fuel prior to its admission to the carburetor, and

means for circulating refrigerant fluid to and from said heat exchange means in heat exchanging relation with said fuel.

12. The combination of claim 11 wherein said means for circulating refrigerant fluid to and from said heat exchange means comprises the air conditioning system of an automobile in which said engine is mounted.

13. The combination of claim 12 wherein said heat exchange means for cooling the fuel is disposed in front of the fire wall of an automobile in which said engine is mounted.

14. The combination of claim 12 wherein said heat exchange means for cooling the fuel is mounted and disposed within the air inlet passage leading to said carburetor, and wherein said heat exchange means for cooling the fuel also serves to cool incoming air.

15. In combination, a carburetor for an internal combustion engine, and

means for adjusting the temperature of a fuel-air mixture in accordance with claim 1,

said carburetor having at least one float that controls the volume of liquid fuel and the residence time of said fuel in said carburetor, said carburetor being adjusted to have said float lowered below the level appropriate for the carburetor in the absence of said means for adjusting the temperature of the fuel-air mixture, and having its jet or jets reduced in size to at least 10% smaller opening diameter than appropriate for the carburetor in the absence of said means for adjusting the temperature of the fuel-air mixture.

16. The combination of claim 15 wherein said means for circulating refrigerant fluid comprises the air conditioning system of an automobile in which said carburetor and said means for adjusting the temperature of the fuel-air mixture are mounted.

17. The combination of claim 15 including heat exchange means for cooling the fuel, disposed to cool the fuel prior to its admission to the carburetor, and

means for circulating refrigerant fluid to and from said heat exchange means in heat exchanging relation with said fuel.

18. The combination of claim 15, having its jet or jets reduced in size to at least a 20% smaller diameter opening that would be appropriate for the carburetor in the absence of the means for adjusting the temperature of the fuel-air mixture in accordance with claim 1.

19. The combination of claim 18 wherein said jet or jets are reduced in size of opening to the range from 30% to 50% of the diameter of opening that would be appropriate for the carburetor in the absence of the means for adjusting the temperature of the fuel-air mixture in accordance with claim 1.

20. In the combination of claim 15, 18, or 19, an internal combustion engine having at least one spark plug, said spark plug being at least two ranges hotter than appropriate for such an engine having an unmodified carburetor mounted directly on its manifold, without the benefit of the temperature adjusting means of claim 1.

21. In the combination of claim 20, said spark plug being at least three ranges hotter than appropriate for such an engine having a carburetor mounted directly on its manifold, without the benefit of the temperature adjusting means of claim 1.

22. A process for improving the performance of an internal combustion engine that is equipped with a carburetor and an intake manifold, comprising adjusting the temperature of the fuel-air mixture by cooling it just before or as it enters the inlet port of the intake manifold, to a temperature not above about 40°F (4°C).

23. The process of claim 22, including precooling the fuel before it is delivered to the carburetor, so that it is delivered to the carburetor at a temperature not above about 40°F (4°C).

24. A process according to claim 22 or 23 wherein the temperature of the fuel-air mixture, after it leaves the carburetor and as it enters the intake of the manifold, is not above about 35°F (2°C).

25. A process according to claim 24 wherein the fuel is precooled before it is delivered to the carburetor to a temperature not above about 30°F (-1°C).

26. A process according to claim 22 or 23 wherein the cooling is accomplished by heat exchange with a circulating refrigerant fluid.

27. A process according to claim 26 wherein the refrigerant fluid is circulated by the air conditioning system of an automobile in which said engine is mounted.

28. A process according to claim 22, wherein the temperature of the fuel-air mixture, after it leaves the carburetor and as it enters the intake of the manifold, is in the range from about -20°F to about 30°F (-29°C to -1°C).

29. The process of claim 23, wherein the fuel is precooled before it is delivered to the carburetor to a temperature in the range from about -20°F to about 30°F (-29°C to -1°C).

DECLARATION, POWER OF ATTORNEY, AND PETITION

We, James R. Russell, a citizen of the United States of America residing at 4805 Polk Avenue, Alexandria, Virginia 22304; and James M. Russell, a citizen of the United States of America residing at 4805 Polk Avenue, Alexandria, Virginia 22304, declare that we have read the foregoing specification and claims and we verily believe we are the original, first, and joint inventors of the invention or discovery in

Device and Process for Improving the Performance of an Internal Combustion Engine

described and claimed therein; that we do not know and do not believe the same was ever known or used in the United States of America before our invention thereof, or patented or described in any printed publication in any country before our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by us or our legal representatives or assigns more than twelve months prior to this application, that we acknowledge our duty to disclose information of which we are aware which is material to the examination of this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by us or our legal representatives or assigns, except as follows:

NONE

And we hereby appoint

Frank E. Robbins Registration No. 17,729
James R. Laramie Registration No. 26,934

all of Robbins & Laramie, whose address is 1835 K Street, Northwest, Washington, D.C. 20006, telephone (202) 887-5050, our attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith. Please direct all correspondence and telephone calls to Frank E. Robbins, Registration No. 17,729.

Wherefore we pray that Letters Patent be granted to us for the invention or discovery described and claimed in the foregoing specification and claims, and we hereby subscribe our names to the foregoing specification and claims, declaration, power of attorney, and this petition.

The undersigned petitioners declare further that all statements made herein of their own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Device and Process for Improving the Performance of an Internal Combustion Engine

described and claimed therein; that we do not know and do not believe the same was ever known or used in the United States of America before our invention thereof, or patented or described in any printed publication in any country before our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by us or our legal representatives or assigns more than twelve months prior to this application, that we acknowledge our duty to disclose information of which we are aware which is material to the examination of this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by us or our legal representatives or assigns, except as follows:

NONE

And we hereby appoint

Frank E. Robbins Registration No. 17,729

James R. Laramie Registration No. 26,934

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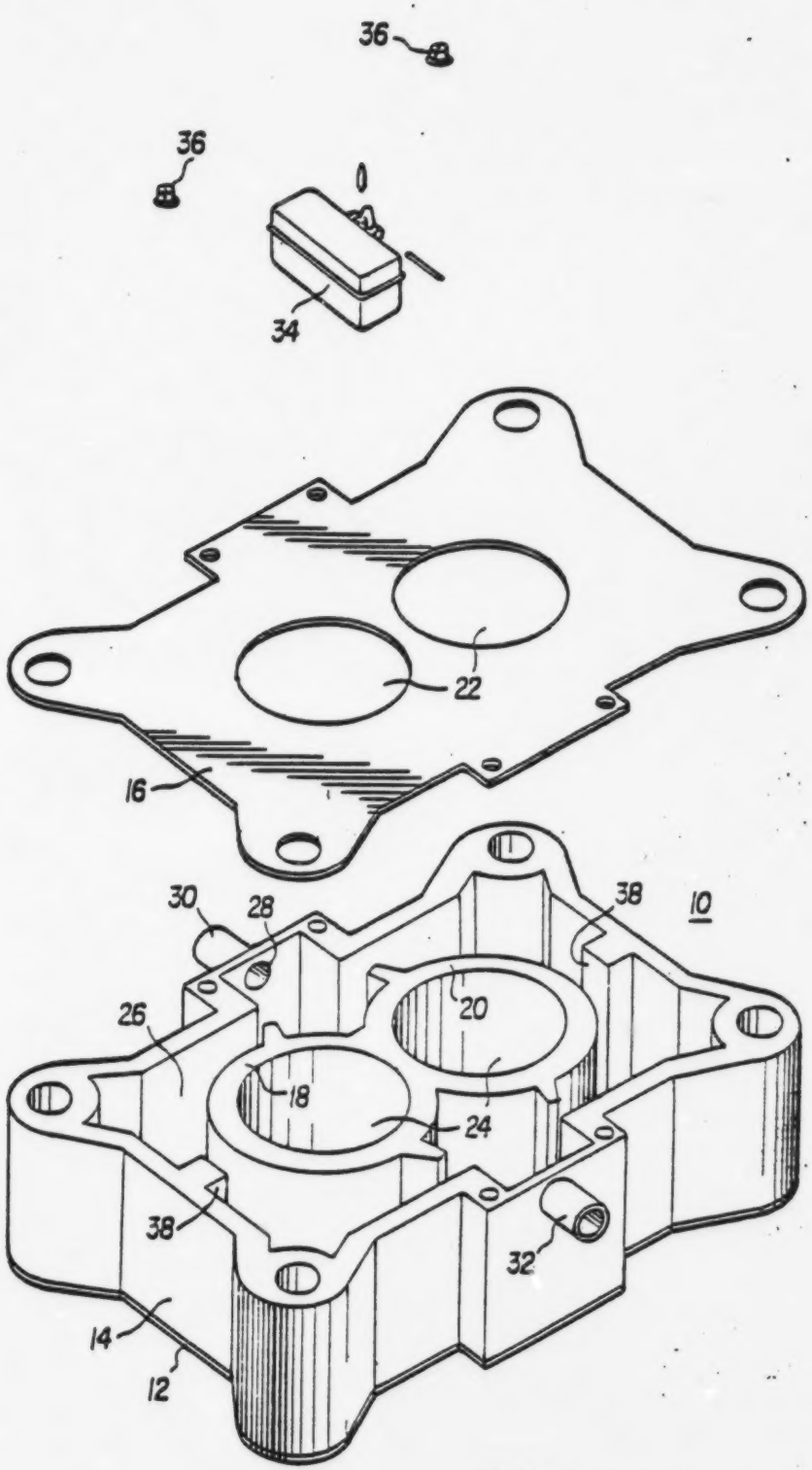

FIG. 1

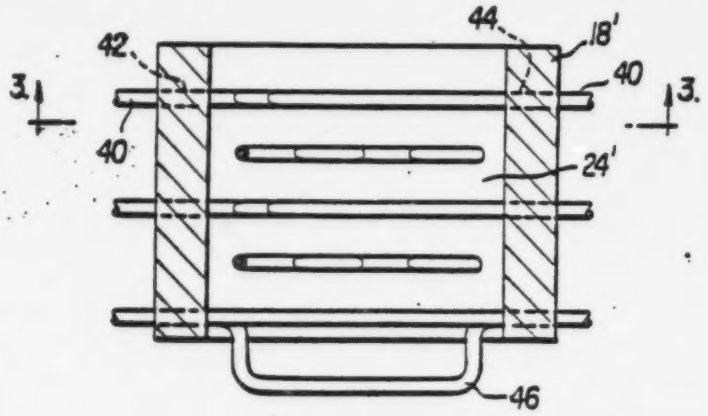

FIG. 2

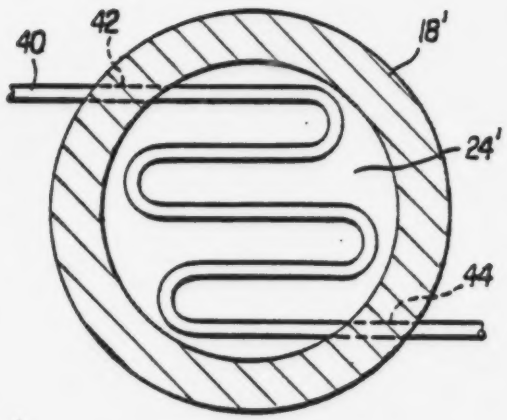

FIG. 3

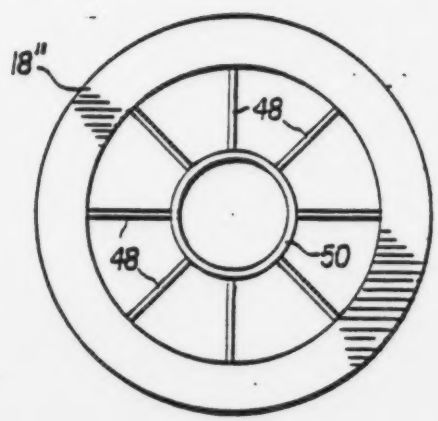

FIG. 4

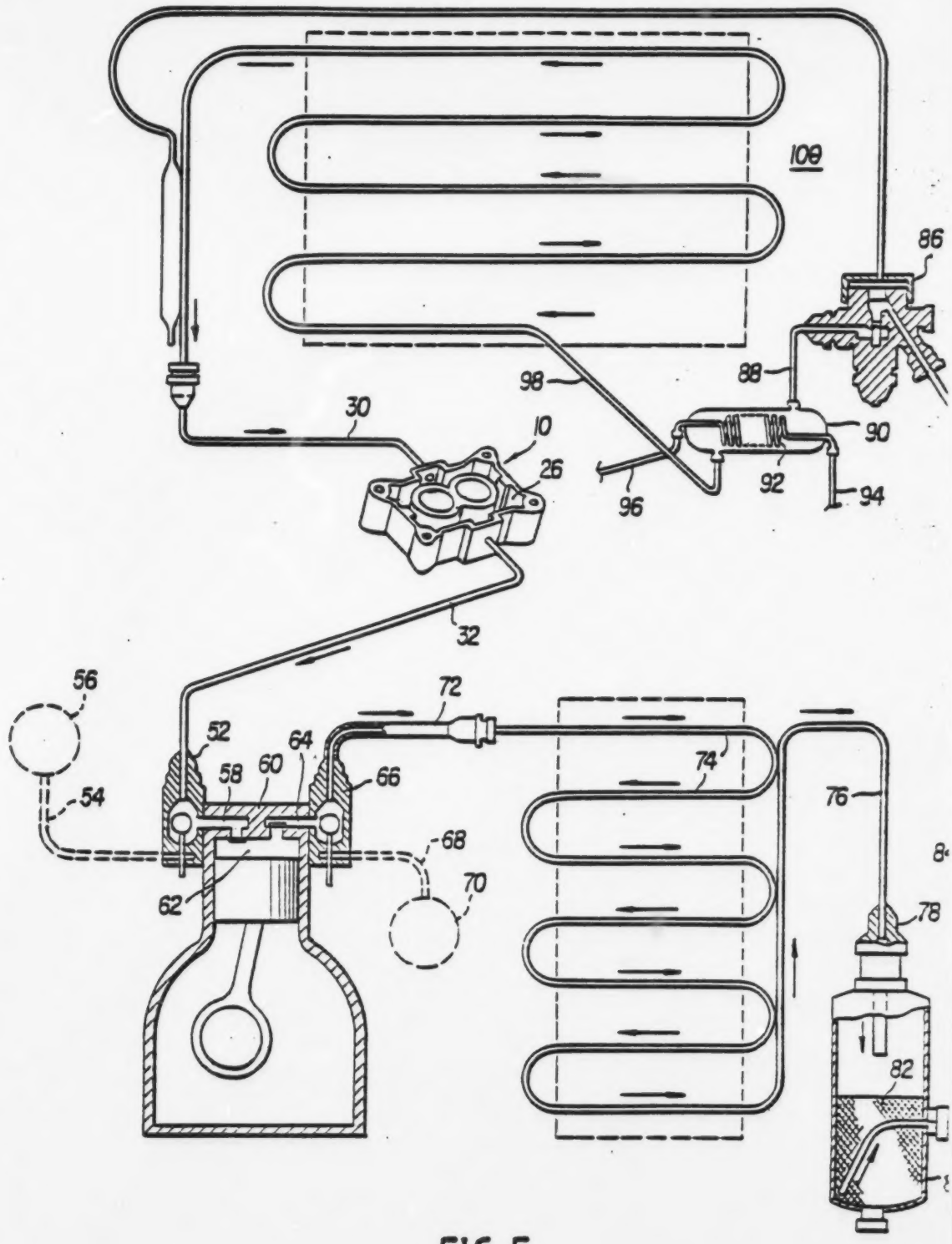
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FIG. 5

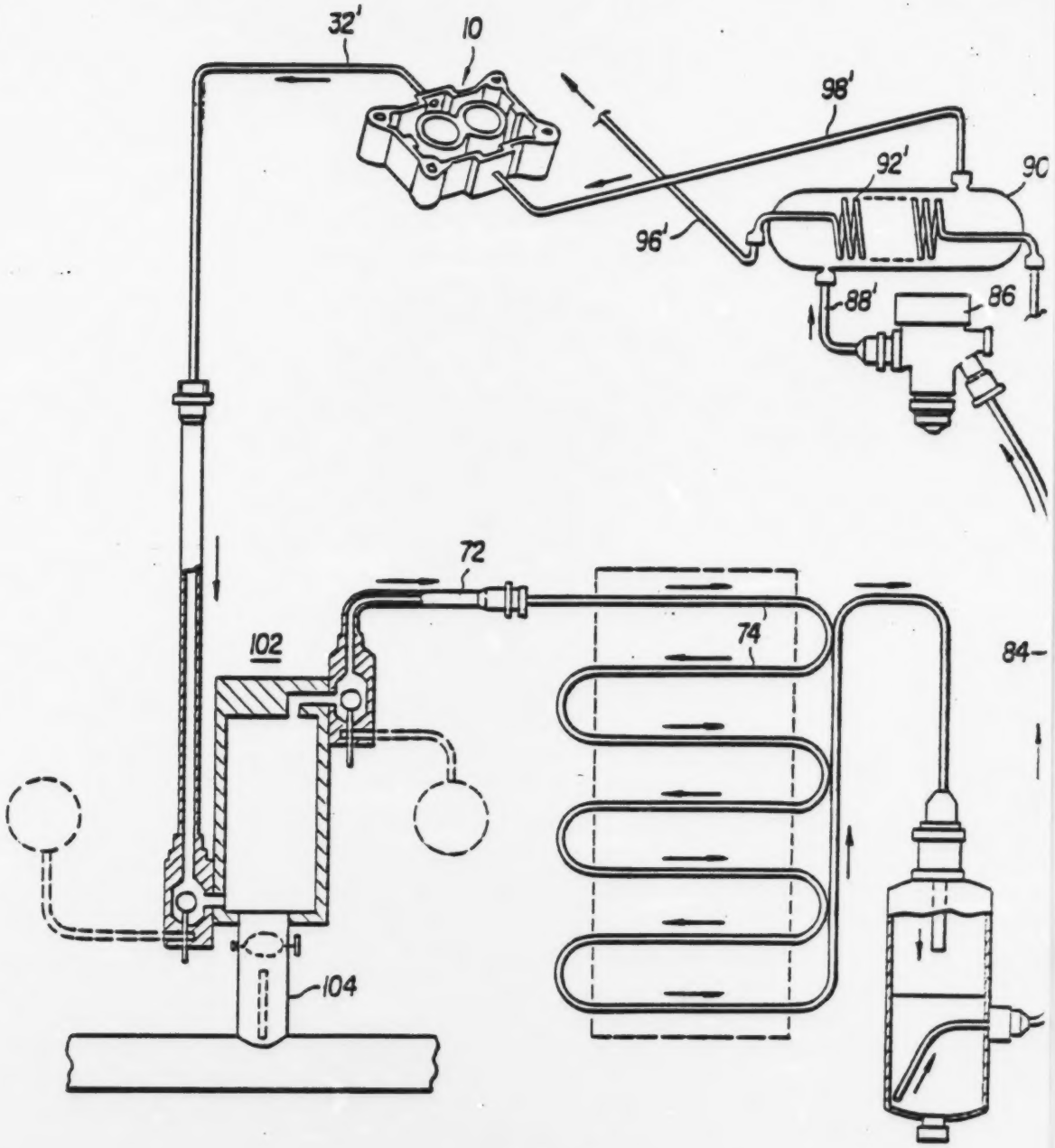


FIG. 6

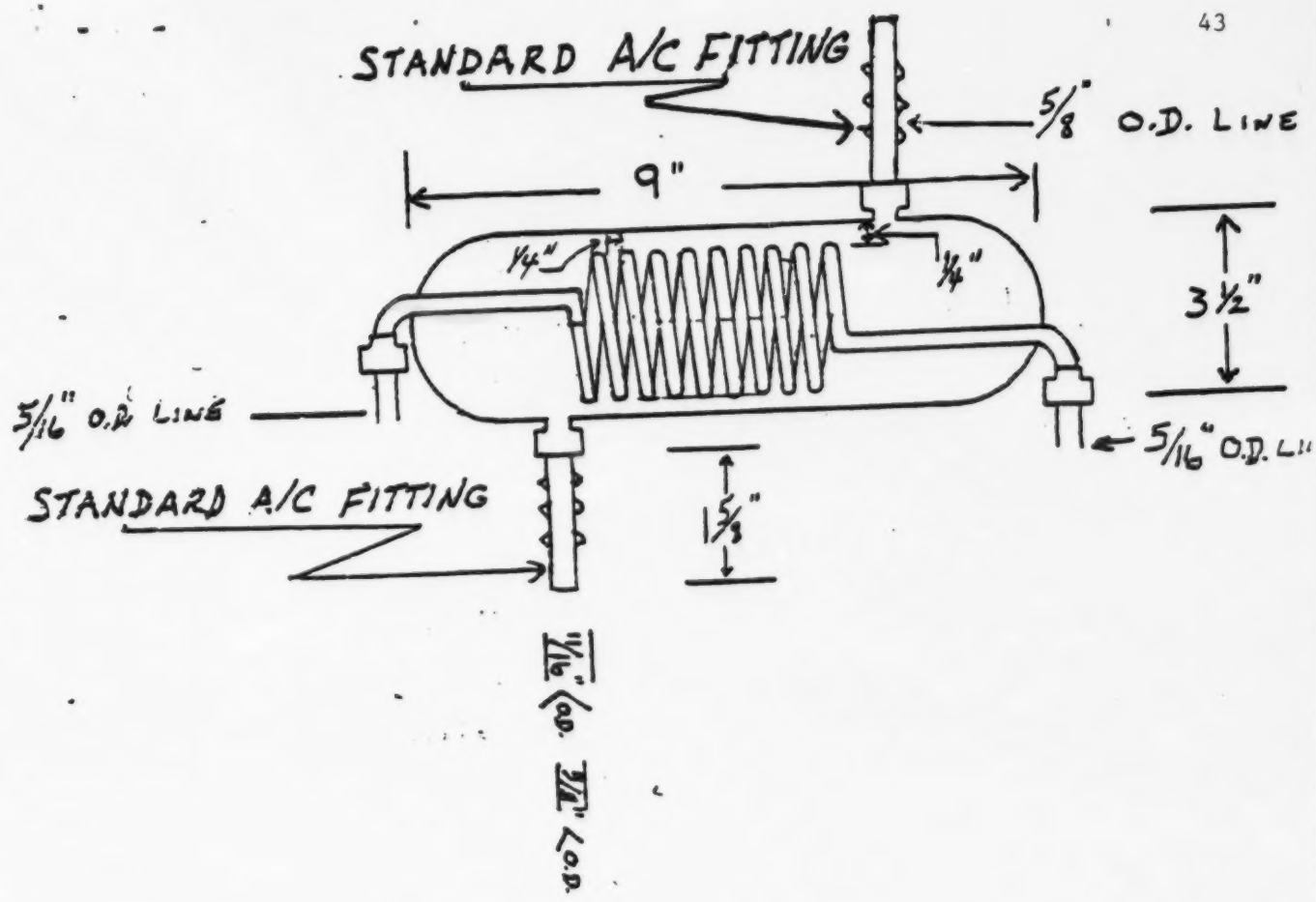
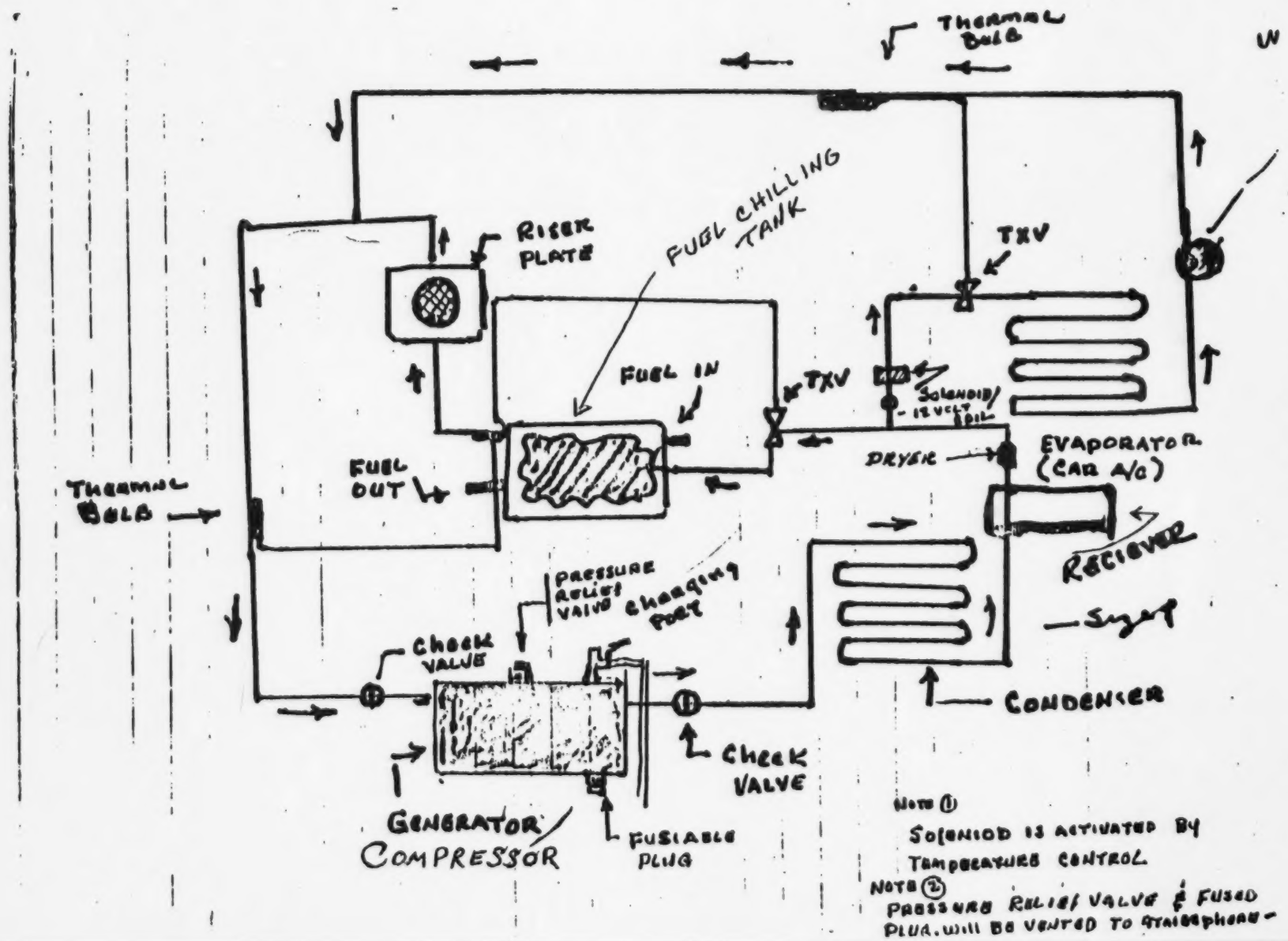

STANDARD A/C FITTING
5/8" O.D. LINE
9"
1/4"
1/4"
3 1/2"
5/16" O.D. LINE
5/16" O.D. LI
STANDARD A/C FITTING
1 5/8"
11/16" O.D.
11/16" O.D.

FIG 7



NOTE (1)
SOLENOID IS ACTIVATED BY TEMPERATURE CONTROL

NOTE (2)
PRESSURE RELIEF VALVE & FUSED PLUG WILL BE VENTED TO ATMOSPHERE

Exhibits 1, 2, 3, and 4

EPA could not obtain legible copies of the subject documents and therefore, they have not been made part of this Attachment. Individuals may request copies of these documents from: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Sources, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, MI 48105. (313) 668-4299.

~~PROPRIETARY INFORMATION~~

~~THIS DISCLOSURE CONTAINS INFORMATION WHICH IS (a) A TRADE SECRET OR (b) COMMERCIAL OR FINANCIAL INFORMATION THAT IS PRIVILEGED OR CONFIDENTIAL.~~

DISCLOSURE DOCUMENT

TITLE: Device and Process for Improving the Performance of an Internal Combustion Engine. Common Title: Russell Fuelmiser.

PURPOSE OF THE INVENTION: The invention described herein improves the performance of the internal combustion engine and thereby improves the mileage delivered by a given quantity of fuel and reduces the pollutants emitted by the exhaust system.

Following is a simple narrative describing the function and process of the invention. A more detailed and complete description and drawings are contained further within the Disclosure Document:

PATH OF THE REFRIGERANT: Refrigerant leaves the air conditioning condenser, passes through the expansion valve and enters the fuel-chilling tank. The refrigerant surrounds and chills the fuel which is passing through the coils within the fuel-chilling tank, and exits the fuel-chilling tank. The refrigerant proceeds to enter the 'riser' which is placed under the carburetor and on top of the intake manifold. The refrigerant cools the air/fuel mixture within the throat(s) of the 'riser' and exits the 'riser' enroute to the compressor thus completing the cycle.

PATH OF THE FUEL: The fuel leaves the fuel pump and enters the fuel-chilling tank. While passing through the coils contained within the fuel-chilling tank, the fuel is chilled by the refrigerant therein, and proceeds to the carburetor inlet. The fuel enters the float chamber (inwhich the float level has been lowered), passes through the carburetor jets, (in which the orifice size has been reduced), and thence through the 'riser' where the fuel/air mixture is again chilled, and enters the intake maniford enroute to the combustion chambers. The spark plug heat range is increased as appropriate to the jet orifice size in conjunction with fuel, air and temperature.

THE EXISTING METHODS: No existing method of increasing fuel mileage and/or reducing pollutant emissions duplicates the function of this invention. There are however, several devices being marketed today which 'claim' to increase fuel mileage and/or reduce pollutants. NONE uses the proces or system described herein.

STATUS OF THE INVENTION: Our test results, (Encls No. 5,6,7,and 8), were produced by tests on equipment and using methods which closely duplicate the methods and equipment used by the Enviornmental Protection Agency (EPA), for their evaluations. Our tests were conducted on the Sun Electric Mark XI Dynomometer and very accurately demonstrate a substantial increase in fuel mileage. Test results have varied from a 50 per cent increase in fuel mileage, (never less), to a 100 per cent increase in fuel mileage. We need to develop an accurate determination of the proper ratio of air, fuel, jet size, temperature, and spark plug heat range in order to achieve the maximum performance possible for various engine sizes, fuels and fuel systems. This must be done so that a dependable determination of mileage increase can be accurately predicted and the full potention of the invention can be realized. Given the range of fluctuation of fuel mileage increases -50 to 100 per cent- we feel the higher range of increase percentage is imminently possible, with great probability of exceeding the 100 per cent mark.(See enclocure 4 wherein it states that less than 20 per cent of the fuel energy is converted into energy for a car's performance).

It is not a question of whether the invention works, it is merely a matter of how well!

Testing on fuel injection engines and diesel engines has been

Russell Fuelmiser cont.

cursory. We have used only the 'historical' method of testing which is totally unscientific and inaccurate except when conducted over a prescribed course, using professional drivers (two per car), and is timed to the second over the entire course and at critical points within the course. This is usually a most expensive, time consuming and less accurate method of conducting these tests than using the dynomometer. To date, our tests results on diesel engines (not documented by dynomometer tests), indicate a fuel mileage increase of 30 percent. Tests with the fuel injected engine portend a fuel mileage increase in excess of 75 percent.

We have not begun testing engines converted to natural gas, propane, methane, etc., nor on rotary or turbine engines. We anticipate continuing development and testing of the previously tested engines before embarking upon these tests unless sufficient capital and equipment for such tests become available. Most of the test equipment and materials to be used in such tests of these engines is the same used in the development and testing of the carburetor, fuel injected and diesel engine.

The total impact of the successful development of this invention in just the basic areas mentioned, (carburetor, fuel injected and diesel engines), on the United States alone is incalculable. A prudent assessment can be made. The United States currently spends $224 million each day on imported oil. Annually that is over $80 billion which can be saved each year.

Our military vehicles,(trucks, tanks, personnel carriers, artillery pieces, light planes, etc.) use gasoline and diesel fueled engines for motive power. An increase of only 25% in the "battle field day",(the length of time equipment can operate on the battle field without resupply), for our military forces would provide the U.S. Armed Forces with an advantage that just cannot be evaluated in dollars and cents.

Small craft of the U.S. Navy, larger craft of our Naval and Maritime Service and various size craft of our fishing fleets and myriad size pleasure craft used at sea and upon inland waterways use gasoline and diesel engine power. A minimum decrease of only 25% in fuel usage for these ships and boats is beyond our accurate calculation or 'prudent' assessment.

There are approximately 170 million passenger cars and trucks operating on the highways of the U.S. today. Our automobile industry produces approximately 6 million such vehicles each year and we import approximately 4 million foreign automobiles each year. Even the minimum 50% fuel mileage increase already demonstrated would save U.S. citizens billions of dollars each year and, as important, break the yoke of our dependency upon expensive imported oil which has been imposed upon us by the OPEC nations.

Sharing this invention with other industrialized nations would impact significantly upon the political aspect of our future negotiations with all the nations of the world.

The Energy Research Corporation (Encl. 4), estimates that less than 20% of fuel used in internal combustion engines is converted into energy for a car's performance. Even if their estimate should be proven true, our invention at this early stage of development has demonstrated , and documented, mileage increases that make their figures moot.

Without considering the savings accruing to our government or its citizens; the ransom imposed upon us by the OPEC countries will be broken. We will no longer have to be dependent upon or responsive to the whims of a few individuals who control the OPEC national policies of oil exportation.

November 16, 1981

Mr. James M. Russell, President
J.C.A. Corporation
1307 E. Capitol Street, N.E.
Washington, D.C. 20003

Dear Mr. Russell:

I have received your letter of October 26 in which you applied for an EPA evaluation of the "Russell Fuelmiser" under Section 511 of the Motor Vehicle Information and Cost Savings Act. The contents of your application have been reviewed by our Engineering Evaluation Group. Following are their comments and requests for clarifications or additional information.

1. Is the device currently available to the public? If so, how is it being marketed and what is the suggested retail price?

2. With regard to installation of the device, do you forsee any clearance problems due to the additional height of the carburetor? Are you certain that only two models of the riser will be able to accommodate the complete range of carburetors in use today? Have you developed any installation instructions beyond the sections in your Enclosures 1 and 2? We are interested in reviewing the actual documents which will be supplied with the device. Your instructions include lowering the float level, installation of smaller jets and use of spark plugs with a higher heat range. Are there any other adjustments required, e.g., timing, idle mixture, or choke, to optimize the performance of the device?

3. In the operation of the device, it appears that the vehicles air conditioner must be on at all times. If this is true, how were the air conditioning controls set for each of the tests at Custom Engineering? How well can a modified vehicle operate if the air conditioner is broken or is not used?

4. According to your application, the fuel-air mixture is cooled substantially before it enters the intake manifold. While the fuel itself could be chilled in advance, we believe that the amount of heat that could be drawn from the mixture is insignificant. Do you have any data which compares the temperatures of the incoming charge with and without your device? How does your device prevent carburetor icing and ensure proper vaporization of the fuel? Can it be effective in all climates during all seasons of the year?

5. We have reviewed the test results you supplied with your application. These include data from Custom Engineering and results from another facility which used a Sun Dynamometer. Although testing on a Sun Dynamometer is not recognized by EPA as an official technique to evaluate devices, we will consider the results. Please provide more information on these latter tests such as the name and location of the laboratory, details on the test vehicles and how they were prepared for each test. In one statement in Enclosure 2, you note "Test results have varied from a 50 percent increase in fuel mileage, (never less) to a 100 percent increase in fuel mileage." The results which accompany this enclosure indicate several instances where the increase was outside this range, primarily on the low side. There also appear to be several anomalies in the test data from the Sun Dynamometer. The 1969 Chrysler was apparently tested at 77 and 78 horsepower at 31 and 30 miles per hour, respectively. This type of loading is not generally representative of typical driving. The results for the 1981 Chevrolet appear to have been obtained at two different speeds while the tests on the 1978 Chevrolet seem to have been conducted at different loads.

   The results from Custom Engineering have also given us some cause for concern. Although we require duplicate test sequences on two vehicles with and without the device, you submitted triplicate test sequences on only one vehicle. The results of these tests do not support your claims for a fuel economy benefit. We acknowledge your contention that the additional water vapor introduced into the combustion chamber causes carbon particles to be released but do not feel that this phenomenon, if present, would have any measurable effect on the carbon balance calculation. The steady state tests which were conducted at Custom Engineering are not recognized by EPA as appropriate but we have considered them. Please provide more information on the test vehicles and the procedures used by your personnel to prepare the vehicles for testing. Not only did my original letter indicate the need for two test vehicles, it also specified that devices which require parameter adjustments also need a third test configuration - one with the parameters adjusted but without the device. You should include this configuration in your future testing. I am prepared to help you develop an appropriate plan.

Your responses to the questions above will be required before we can procedd with the EPA evaluation of your device. Since we intend to conduct these evaluations on a timely basis, we have established a schedule for each. Please submit your response to this letter by December 14. If you have any questions or require further information, please contact me. My telephone number is (313) 668-4299.

Sincerely,

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

March 24, 1982

Mr. James M. Russell
J.C.A. Corporation
45 L Street, N.W.
B 24311
Washington, DC 20024-1611

Dear Mr. Russell:

In a letter dated November 16, 1981, we asked for additional information on your application for an EPA evaluation of the "Russell Fuelmiser". Your letter of February 1 stated the information would be on its way within thirty days. We have not yet received your response.

In order for us to evaluate your device on a timely basis, we ask that this information be submitted by April 9. Otherwise, we will complete our evaluation using the information we have. A copy of our report will be sent to you prior to its announcement in the Federal Register. Please contact me as soon as possible if you have any questions. I am looking forward to hearing from you.

Sincerely,

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch

J.C.A. CORPORATION

8 April 1982

45 L Street S.W.
B/24311
Washington, D.C. 2004-1611
(202) 554-5332
(703) 370-4937

Mr. Merrill E. Korth
U.S.Environmental Protection Agency
Office of Air and Waste Management
Ann Arbor, Michigan 48105

Dear Mr. Korth:

I shall respond to your Nov 16, 1981 letter,(remailed on January 13, 1982), paragraph by paragraph thus providing us a mutually available reference. All paragraph numbers refer to your letter.

1. No. It is not now available to the public. Tooling is in the process of completion.

2. We have experienced clearance problems on the Cadillac El Dorado. This was easily corrected by changing gaskets. I am not certain that only two (2) models of the riser will be able to accomodate all carburetor-intake manifolds. We do plan to produce risers with multiple bolt patterns. Even so, we still shall probably have to produce more than two (2) riser models. (I shall deal separately with installation instructions).

3. Yes. The vehicle air conditioner is to be on at all times. The air conditioner was operating during all tests. A modified vehicle,(with Fuelmiser device installed), will operate if the air conditioner is broken. The vehicle will not achieve nearly the same fuel economy, it will run hotter and will probably diesel. Proper installation of the device permits the A/C compressor to function (for benefit of the device) as well as permitting the heater to operate when necessary, for comfort of the passengers. They may both operate at the same time summer or winter.

4. Please observe that the chilled fuel enters the carburetor and ambient air and chilled fuel pass through a frosted riser. I have no temperature comparisons. I have never seen an "iced" carburetor nor have I been able to locate an auto mechanic who has seen one on a car. The engine compartment temperature is quite hot, especially in newer cars, regardless of seasonal temperatures. We are not freezing the fuel (-274°) merely chilling it.

Our device does not have the capability of freezing the fuel. Water in the fuel was, in days past, a problem and our device could possibly freeze it under the proper conditions. That amount of water passing the filtering devices probably would cause the engine to malfunction anyway. We have run several cars through this past winter, in which sub-zero temperatures were common, with no difficulty at all. The engine answers the question of proper vaporization by functioning better and delivering an infinitely better fuel economy. We have not experienced any seasonal difficulties or changes in engine/device performance due to seasonal changes. Sensors controlling the A/C compressor maintain the riser and fuel chilling tank at a constant temperature.

5. Tests using the Sun Electric Dynomometer (Roadomatic Mark XI) were conducted by personnel at the:

Norris Garage
5509 Livingston Road
Forest Heights, Md. 20021

The engines were prepared as stated in the disclosure documents in that the engines were tuned without the device and tested. Then the device was installed, the engine again tuned and tested. Our statement of 50% increase in fuel mileage (never less) was (is) based on cumulative mileage. You may note that in several instances, at different speeds, the mileage increases exceed 100%! We had no actual control over the tests on the Sun machine. The operator was asked to subject the autos to before and after tests using the same simulated conditions. The 'triplicate' test sequence from Custom Engineering was submitted to you only as part of what they had in-fact done. We have explained the reason for invalidation of the tests other than the seperate source tests. I have examined the pertinent results of testing conducted by Custom Engineering and can find no basis for your statement, "The results of these tests do not support your claim for a fuel economy benefit." In each case, the fuel benefit claimed on a cumulative basis - since vehicles operate over a range of speeds - exceeded 50%. The Ford was in-fact considerably over that figure. The steady-state tests conducted by Custom Engineering were conducted according to EPA procedures, i.e., para 610.42 Federal Register, Part VIII, dated March 23, 1979 and US Environmental Protection Agency, Office of Air and Waste Management Publication Nr. FS-5, Title: EPA Retrofit and Emission Control Device Evaluation Test Policy, Page A-9. Custom Engineering used a graduated buret which was coupled to a timer in hundredths of seconds and a dynomometer when making the steady-state tests. The tests were totally scientific and objective, as attested in their report. The vehicles were first tuned to manufacturers specifications by their personnel and tested. They then had the spark plugs changed, the jets were reduced by 10% on the Ford Truck only, and the device was installed. The carburetors were adjusted for smooth running and the tests were made. Timing was advanced ten degrees (10°).

All adjustments and changes of equipment were made by, or under the supervision of Custom Engineering personnel. The Cadillac El Dorado Biaritz (1978) has continued operation with the device installed. The Ford Pick-Up Truck (1978 3/4 ton) has continued operation with the device installed. Neither has experienced any difficulty in operation for any reason.

I believe that many of your questions could be better directed to Custom Engineering. We were assured by them that they had contacted your office regularly, that they knew exactly the tests you required and that they were totally capable of making such tests. On that basis we paid them over $4,ooo.oo and a like amount was spent on travel and expenses. We can not afford to have to do the whole thing over again.

We have since purchased our own buret and timer and continue to test and work with the device. Our current projects intesting on fuel injected and diesel engines. I shall certainly keep you informed of results.

Thank for your kind assistance and patient consideration.

Sincerely yours,

James M. Russell

JAMES M. RUSSELL
President

Attachment F

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

May 24, 1982

Mr. James M. Russell
4805 Polk Ave.
Alexandria, VA 22304

Dear Mr. Russell:

The Post office has repeatedly returned our letters addressed to the address on your company letterhead. As a result, I am send this letter to your home address.

I have received your letter of April 8 which responded to our preliminary evaluation letter of November 16. 1981. Although you addressed some of our concerns, you did not address them all. In fact, your letter raised some new questions. These concerns/questions are given below. The item numbers correspond to those listed in your letter.

1. What is the tentative suggested retail price of the device? How do you plan to market it?

2. Have you developed any installation instructions for purchasers of the device? If so, please submit a copy.

   In paragraph 2 of your letter, you did not address whether other changes (e.g., timing, idle mixture, or choke) were required in addition to the changes mentioned in the application, i.e., float level, jet size, and spark plug heat range. However, in paragraph 5 you state "the vehicles tested by Custom Engineering had the spark plugs changed, the jets were reduced by 10% on the Ford truck only, and the device was installed. The carburetors were adjusted for smooth running and the tests were made. Timing was advanced ten degrees (10°)." Based on your statements, it is my understanding that a) the changes in spark plug heat range, float level, and jet size are not required for every vehicle in which the device is installed and b), other adjustments, i.e., timing and idle mixture not mentioned in the application are required for some or all vehicles. Please clarify exactly what adjustments are required and whether they are required for all vehicles. How do you determine which vehicles require engine parameters to be adjusted? How do you determine the specific setting for each parameter?

5. With respect to the tests performed using the SUN Electric Dynamometer you state, "the engines were prepared as stated in the disclosure documents". The disclosure documents do not adequately detail how the engines were prepared. Please clarify what specifications the engine parameters were adjusted to when tested with and without the device.

With respect to tests performed by Custom Engineering, you state, "we have explained the reason for invalidation of the tests other than the separate source tests". Please clarify that statement. Additionally you state, "the steady-state tests conducted by Custom Engineering were conducted according to EPA procedures, i.e., para 610.42, Federal Register Part VIII, dated March 23, 1979." Please note that EPA does not have a specified steady-state test procedure. Further, the referenced Section 610.42 does not address steady-state testing. I would like to bring to your attention that Section 610.40 states, "two chassis dynamometer test procedures, the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET) will generally be used to evaluate the effectiveness of the device supplemented (underline added for emphasis) by steady-state or engine dynamometer tests where warranted." This means that steady-state tests are not used in lieu of FTP and HFET testing. Additionally, Section 610.41 provides that for those devices which require engine parameter adjustments to be made, tests will be performed with the parameters adjusted exclusive of the retrofit hardware. This means that during the test program on the Russell Fuelmiser, each vehicle must be tested in three different configurations. The requirements of replicate testing of at least two vehicles in three configurations using the FTP and HFET procedures were previously explained in my original letter to you.

Further, Section 610.42(b) requires the carbon balance procedure for measuring fuel consumption unless track or road tests are employed. As previously stated in my November 16 letter, we do not believe the release of carbon particles as a result of additional water vapor will have any measurable effect on the carbon balance calculations. Therefore, future testing should be done using the carbon balance method. The gravimetric or volumetric procedures may be used to supplement, the carbon balance method.

Our last comment with respect to Paragraph 5 is that you did not adequately detail all the changes made to the vehicles tested by Custom Engineering. For example, what were the differences in spark plugs? For each test configuration, please provide specific settings for all parameters that were subject to adjustment.

Thus, in addition to clarifying certain portions of your letter, we still need new test data. I am prepared to help you develop an appropriate plan.